T05D08 – IB SL Energetics Exam MS

For free response questions, the data booklet used will effect your answers for Bond energy problems, check work!

1. C
2. D
3. D
4. C
5. C
6. C
7. C
8. C
9. B
10. A
11. C
12. C
13. B
14. D
15. D
16. D
17. C
18. A
19. B
20. C
21. D
22. D
23. A
24. B

25. (a) $\Delta T = 23.70 - 23.03 = 0.67$ (°C/K); 1

(b) $n = \left(\frac{0.4385\ \text{g}}{342.34\ \text{g mol}^{-1}} \right) = 1.281\times10^{-3}$; 1

(c) (i) $\Delta H_C = (C\,\Delta T)/n = \frac{-[(10.114\ \text{kJ K}^{-1})(0.67\ \text{K})]}{(1.281\times10^{-3}\ \text{mol})} = -5.3\times10^{3}\ \text{kJ mol}^{-1}$; 1

Use ECF for values of ΔT and n.

(ii) Percentage experimental error $= \left[\frac{(-5.3\times10^{3}) + (5.6\times10^{3})}{(-5.6\times10^{3})} \right] \times 100 = 5.4\%$; 1

Use ECF for values of ΔH_C.

(d) enthalpy change of combustion of sucrose > TNT, and therefore not important;
rate of reaction for TNT is greater than that of sucrose, so this is valid;
amount of gas generated (in mol) for sucrose > than that of TNT
(according to the given equation), so this is not important; 3

[7]

~~**26.** (a) (Amount of energy required to break bonds of reactants)~~
~~8×412 + 2×348 + 612 + 6×496/7580 (kJ mol^{-1});~~
~~(Amount of energy released during bond formation)~~
~~4×2×743 + 4×2×463/9648 (kJ mol^{-1});~~
~~ΔH = −2068 (kJ or kJ mol^{-1});~~ ~~3~~
~~*ECF from above answers.*~~
~~*Correct answer scores **[3]**.*~~
~~*Award **[2]** for (+)2068.*~~
~~*If any other units apply **−1(U)**, but only once per paper.*~~

~~(b) exothermic **and** $\Delta H^{\ominus}$ is negative/energy is released; 1~~
~~*Apply ECF to sign of answer in part (a).*~~
~~*Do not mark if no answer to (a).*~~

~~**[4]**~~

27. (a) (i) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$; 1
State symbols not required for mark

(ii) products more stable than reactants/reactants less stable than products;
products lower in energy/reactants higher in energy; 2

(iii) (overall) bonds in reactants weaker/(overall) bonds in product stronger /all bonds in product are σ bonds/weaker π bond broken and a (stronger) σ bond formed;
less energy needed to break weaker bonds/more energy produced to make stronger bonds (thus reaction is exothermic)/*OWTTE*;
OR
bond breaking is endothermic/requires energy and bond making is exothermic/releases energy;
stronger bonds in product mean process is exothermic overall; 2

[5]

28. $-1 \times \Delta H_1/676$;
$1 \times \Delta H_2/-394$;
$2 \times \Delta H_3/-484$;
$\Delta H_4 = -202$ (kJ mol^{-1}); 4
Accept alternative methods.
*Correct answers score **[4]**.*
*Award **[3]** for (+)202 or (+)40 (kJ/kJ mol^{-1}).*
-1(U) if units incorrect (ignore if absent).

[4]

29. (a) amount of energy needed to break one mole of (covalent) bonds;
in the gaseous state;
average calculated from a range of compounds; 2
*Award **[1]** each for any two points above.*

(b) bonds broken: $161 + 2\times348 + 8\times412 + 6\times496/7580$ kJ mol^{-1};
bonds made: $8\times743 + 8\times463/9648$ kJ mol^{-1};
(bonds broken - bonds made =) $\Delta H = -2068$(kJ mol^{-1}); 3
*Award **[3]** for the correct answer.*
Allow full ECF - 1 mistake equals 1 penalty.
Allow kJ but not other wrong units.

(c) same/equal, because the same bonds are being broken and formed; 1

(d) products more stable than reactants;
bonds are stronger in products than reactants/$H_P < H_R$/enthalpy/stored energy of products less than reactants; 2

[8]